Mechanical resistance of intumescent coatings

Advances in the development of more efficient and less costly intumescent coatings (ICs) have recently greatly extended the market of such type of fire insulation. Nevertheless, the theoretical understanding necessary to predict the behaviour of IC and translate it in simple but reliable design methods has not kept up with the development of the building sector. Thus, at present, the design of ICs relies on the results of fire tests, based on two unreliable assumptions:

1. that the thermal properties of the IC would only depend on the temperature, so that the test results can be extended to real fires, where the steel elements are heated to the same temperatures, although under different heating regimes;
2. the second assumption is that the mechanical adhesion of the IC on the test sample can well represent the mechanical adhesion of the coating on the loaded and deformed steel profiles of a real structure.

Past studies on the fire performance of IC already highlighted the limits of the first assumption. Tests carried out in the framework of a recent project funded by COWIfonden also indicated that early cracking and detachment of IC can occur depending on several parameters, such as profile shape and position, substrate of the coating, presence of reinforcing mesh, and coating thickness.

This project is aimed at correcting those assumptions and develop a more reliable design method that can be easily integrated in current practice. In particular, an experiment campaign will be carried out at DTU BYG laboratories, aimed at assessing the mechanical response of different types of ICs at ambient temperature and during heating. The comparison of the mechanical behaviour at ambient and high temperature is particularly important for ICs, as, contrarily to inert SFPM, the expansion of the coating during heating may close the cracks and possibly delay or hinder the integrity failure of the insulation. The final aim of the project is to identify a relationship between the deformation of the steel element and loss of integrity of the IC, thus bridging a gap between the increasing use of ICs and the lack of reliability of current design methods, which represents the major limit in the further expansion of the IC market and steel industry.